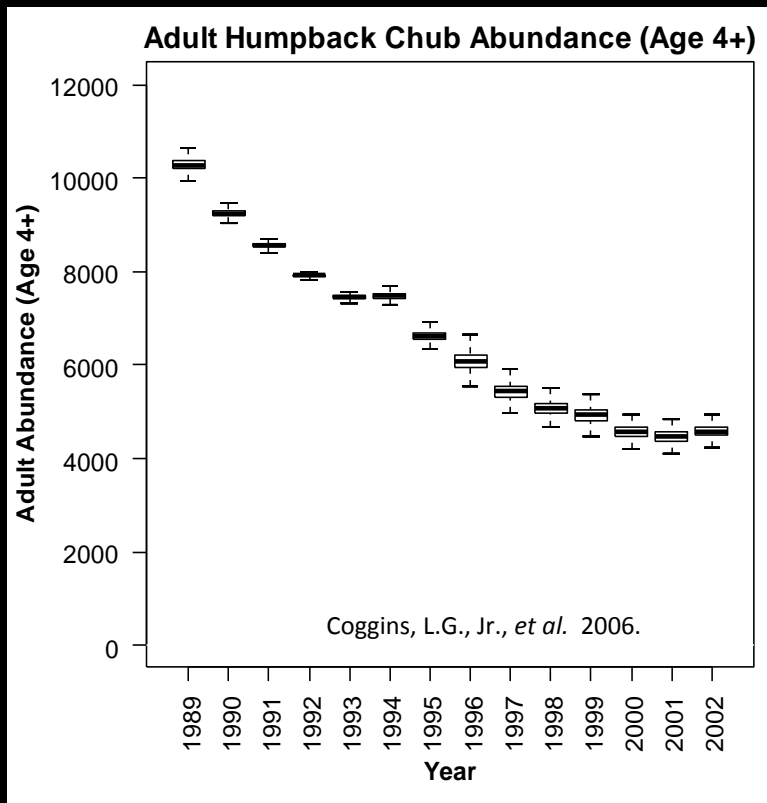


SSQ – 2

Does a decrease in the abundance of rainbow trout and other cold- and warm water nonnatives in Marble and eastern Grand Canyons result in an improvement in the recruitment rate of juvenile humpback chub to the adult population? (FY2006-2011)



Predation is a known source of mortality for HBC



- Annual per-capita consumption rates
 - RBT: 4 fish yr^{-1} upstream, and 10 fish yr^{-1} downstream
 - BNT: 90 fish yr^{-1} upstream and 112 fish yr^{-1} downstream
- RBT 50 times more abundant than BNT
 - RBT predation accounted for more than half of the total fish consumed in the study area.



Predation is a known source of mortality for HBC

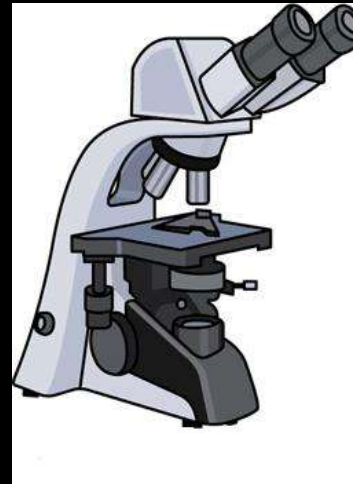
Fine resolution



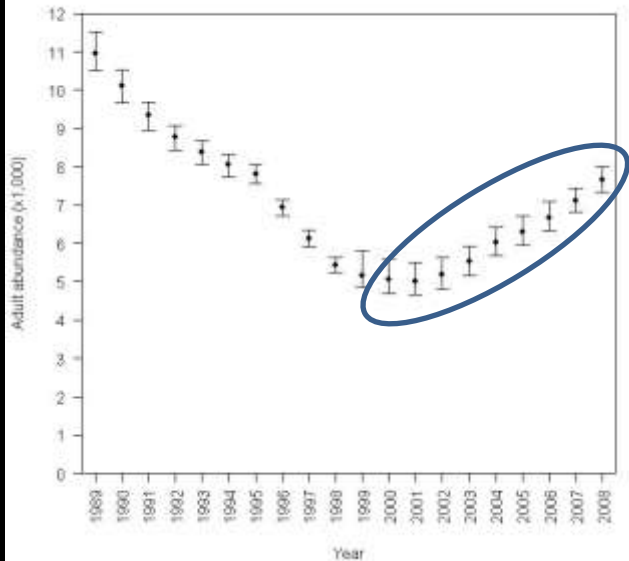
Coarse resolution



- Predator Consumption Ratio (1:20)
 - Ratio of brown trout to rainbow trout
- (Approx.) 200 BNT = 4,000 RBT



Humpback chub



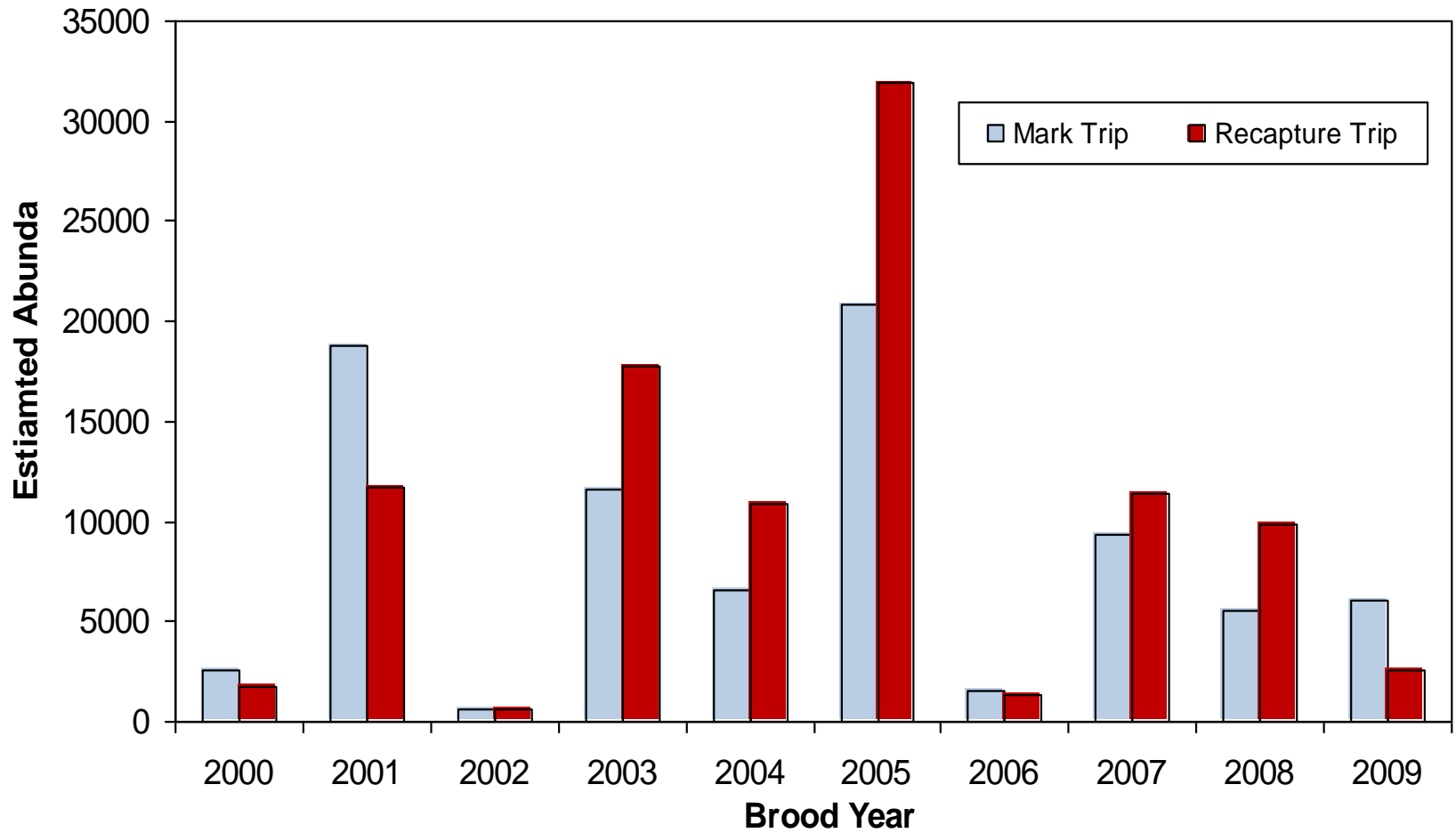
Coggins and Walters (2009) “caution that **recruitment is particularly difficult to estimate for this population** so subsequent assessments that produce recruitment estimates for the **2005-2006 brood years** will be critical for policy evaluation.

Coggins et al. (2011) “...these early signs of **increasing survival and recruitment** are encouraging, they **are not adequate to infer the success of the nonnative removal policy** primarily because of the nearly perfect correlation between the unplanned increases in release water temperature and the magnitude of the nonnative fish reduction.”

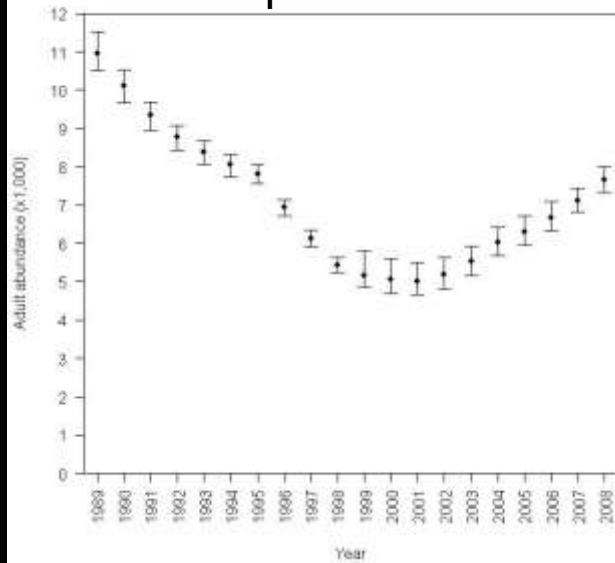
Yard et al. (2011) “Our findings show that humpback chub are vulnerable to trout predation at an individual level, but **it is uncertain whether or not trout piscivory has had a population-level effect** on this endangered species.”



Little Colorado River - FALL
Estimated Fall Abundances of Age-0 HBC



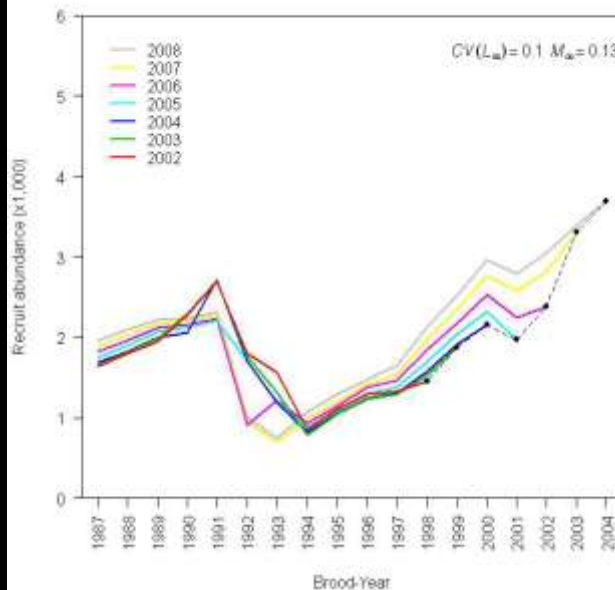
Humpback chub



ASMR Model (Coggins and Walters 2009)

- Indicates an increase in adult population (Age-4+ chub)
- Population response is premature for mechanical removal effect

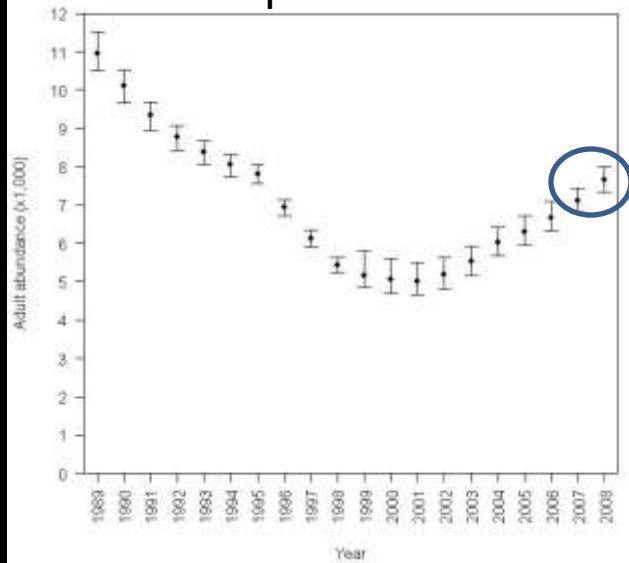
Juvenile Recruitment



Brood year success ?

- Increased recruitment of juvenile HBC
- Started in the late-1990's
- Slight indication of recruitment
 - Mechanical removal (2003-2006)
 - Temperature increases in the CR mainstem

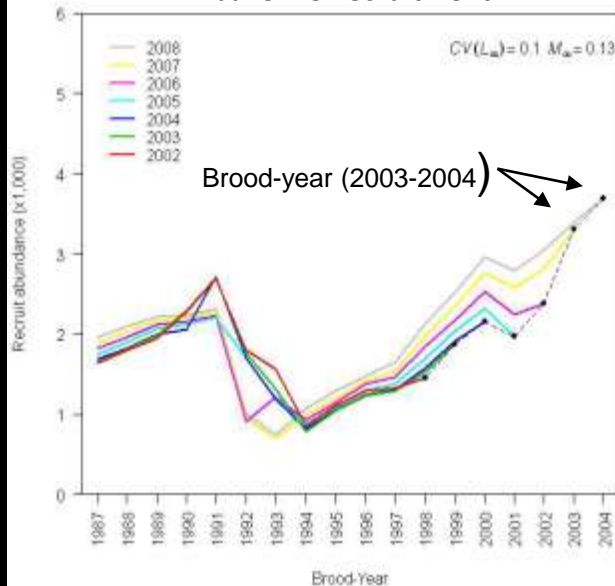
Humpback chub



ASMR Model (Coggins and Walters 2009)

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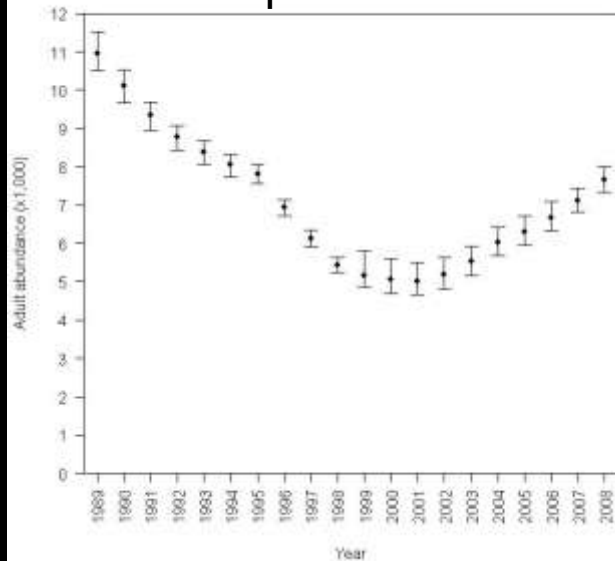
Juvenile Recruitment



Brood year success ?

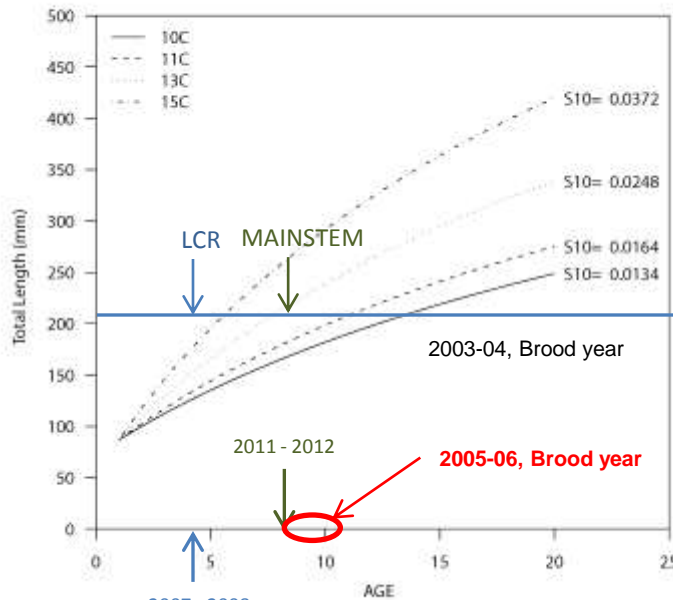
- Increased recruitment of juvenile HBC
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 - Temperature increases in the CR mainstem

Humpback chub



ASMR Model (Coggins and Walters 2009)

- Indicates an increase in adult population (Age-4+ chub)
- Population response is premature for mechanical removal



(Coggins 2008)

Brood year success ?

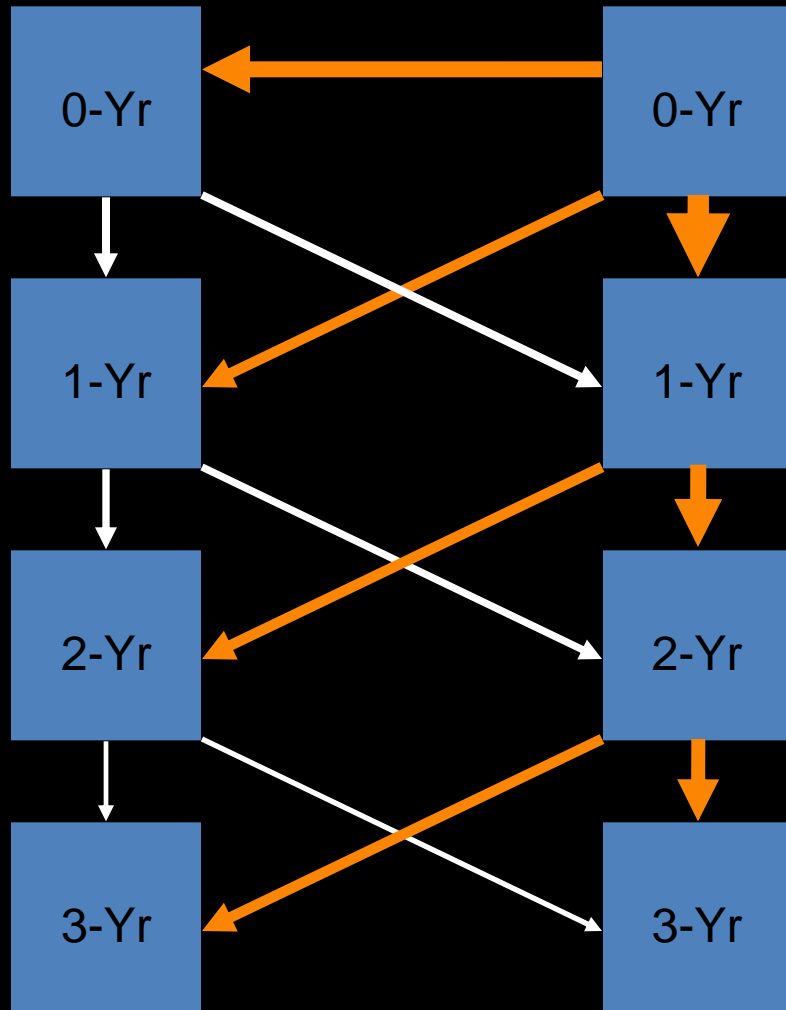
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 - Temperature increases in the CR mainstem

- Petersen J.H. and C.P. Paukert 2005. Development of a Bioenergetics Model for Humpback Chub and Evaluation of Water Temperature Changes in the Grand Canyon, Colorado River
- Paukert C.P. and J.H. Petersen. 2007. Comparative Growth and Consumption Potential of Rainbow Trout and Humpback Chub in the Colorado River, Grand Canyon, Arizona, Under Different Temperature Scenarios
- Findings from Ecopath modeling workshop (2010) suggest that mechanical removal had a strong effect on humpback chub recruitment.
- Coggins L.G., M.D. Yard, W.E. Pine, III. 2011. Nonnative Fish Control in the Colorado River in Grand Canyon, Arizona: An Effective Program or Serendipitous Timing?

HBC Pathways of Movement

CR MAINSTEM

LCR TRIBUTARY

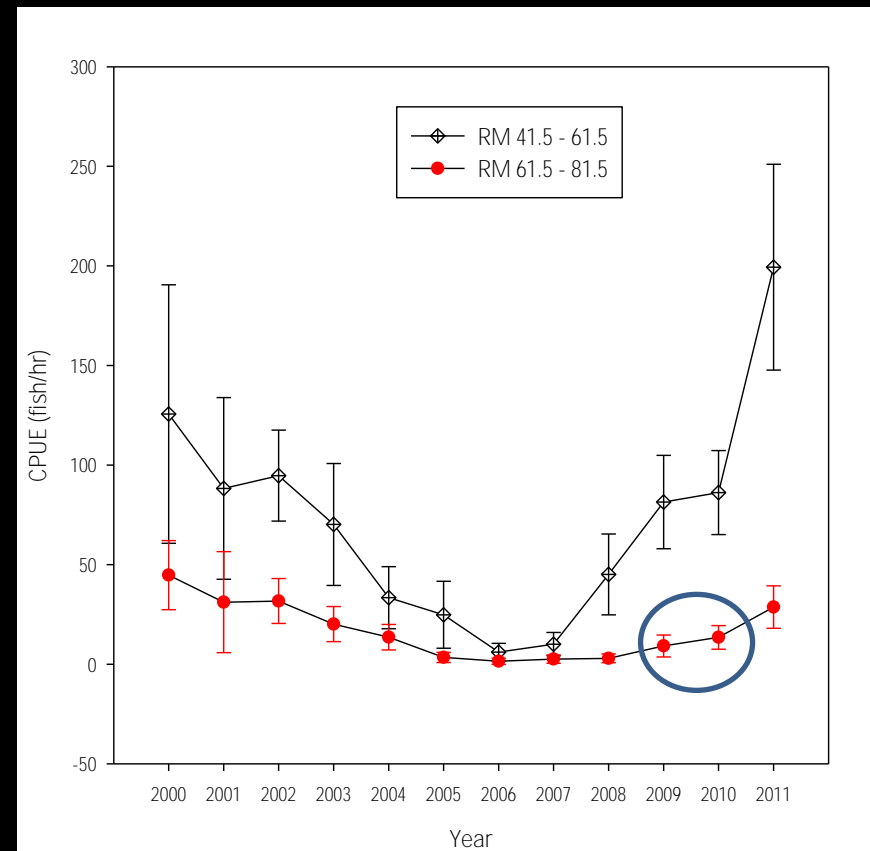
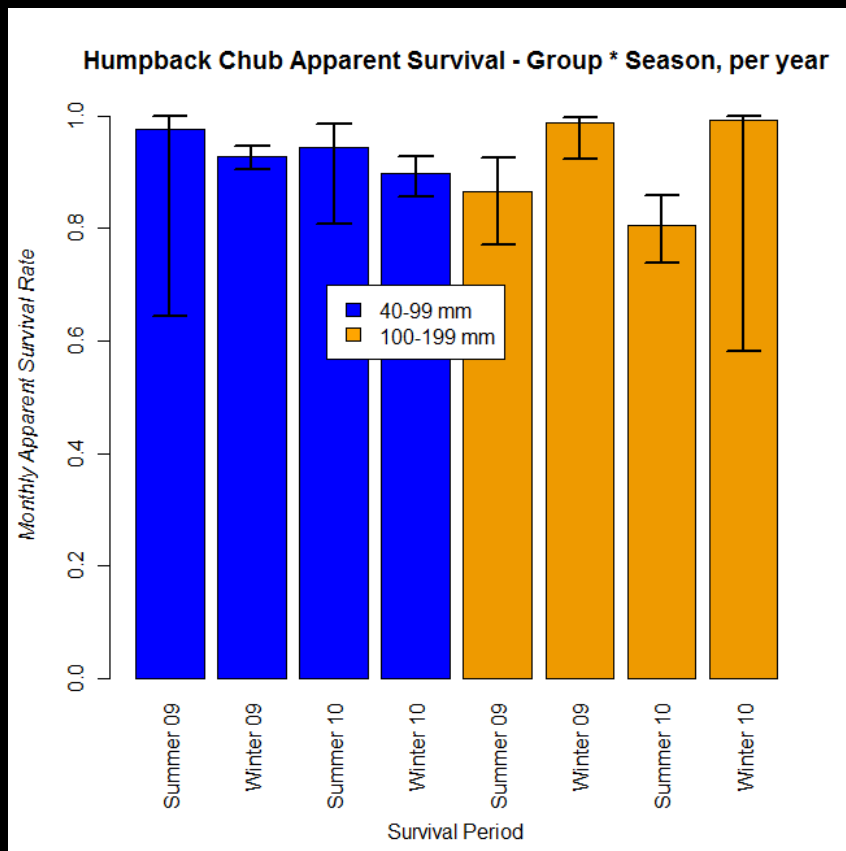


NSE otolith data for native fishes (though minimal samples) suggest that bi-directional movement occurs between the LCR and CR mainstem

NSE catch data suggest strong spatial fidelity to sites for marked fish (VIE & PIT-tags).

Other Lines of Evidence

NSE study – apparent survival estimates for HBC remain high within and between years.



Provisional Data – Subject to Change

Summary

- ASMR model - Humpback chub abundance (7,650 fish, age 4 years or more) has increased significantly since the early 2000's.
- NSE study - Apparent survival rates in the Colorado River mainstem for juvenile fish continue to remain high over what we infer to be increasing RBT trout densities in the LCR confluence area.
- FWS study - annual abundance estimates also suggest increases in chub abundance.

Conclusion

- Current status and trend data are insufficient at this point time to support piscivory as the causal mechanism in the decadal decline in humpback chub (1990-2002).
- Suggest using other experimental approaches to address uncertainties about native and non-native fish interactions.

End